

***Development of Landscape Indicators  
for  
Potential Nutrient Impairment  
of Streams  
in EPA Region 8***

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EPA Region 8**





## ***Surface Waters (Rivers and Streams)***

Population Estimates of Condition for an Area  
with known confidence

Ranking of Stressors

Association of Condition and Stressors

## ***Landscapes***

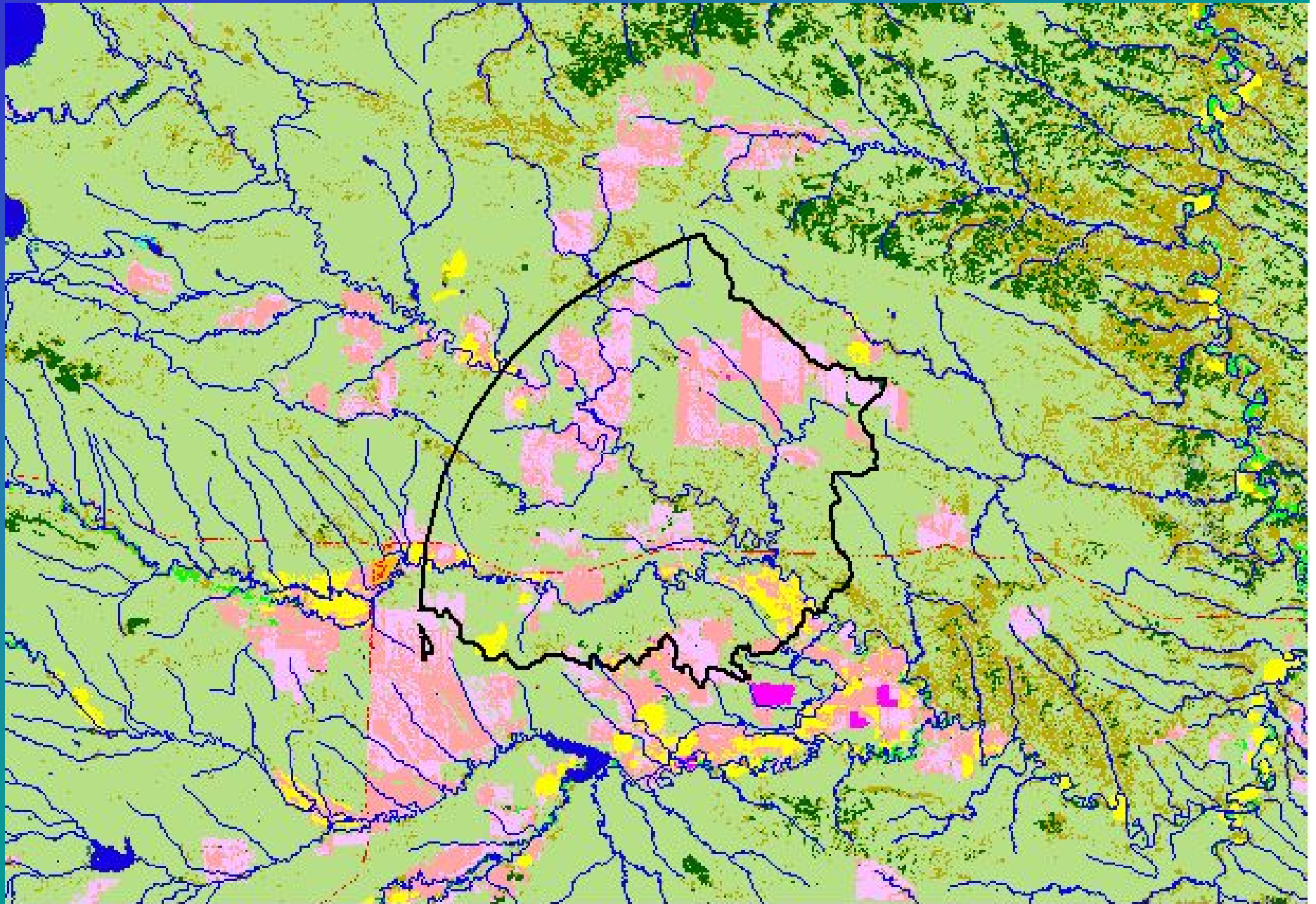
Predicted Conditions across an Area (**WHERE?**)

Association of Condition and Stressors

# ***EMAP-West Landscape Indicator Concepts for Stream Condition***

- **Ecological stream condition is often a function of the watershed composition and disturbance**
- **Many GIS data layers can be used to describe the watershed composition and disturbance**
- **Given an understanding of the relationship between condition and watershed composition and disturbance, models can be developed and applied to predict probable condition in other areas**

## *Land Cover and Streams in a Clipped Site Catchment*



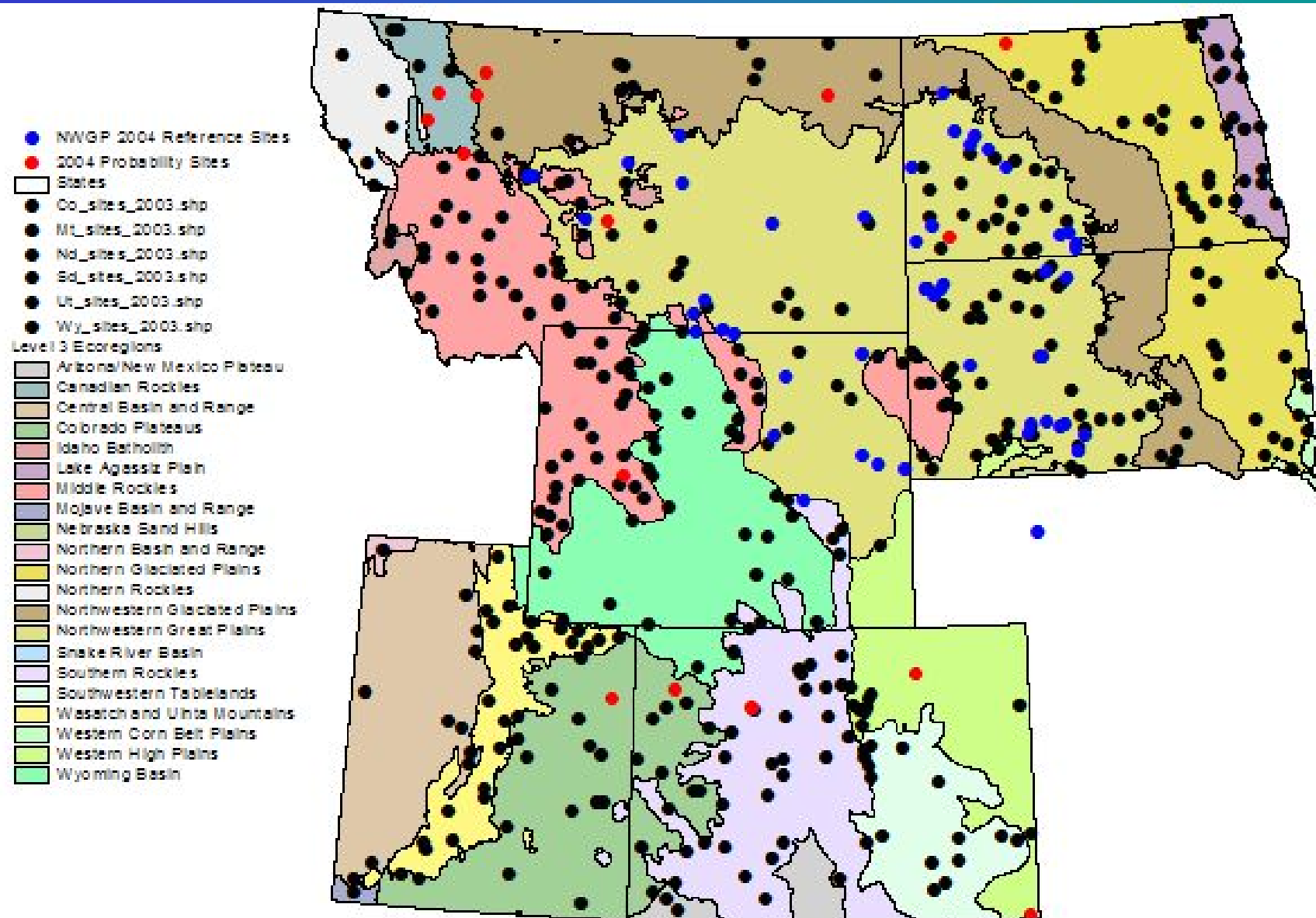
# *Landscape Analysis*

- ***Landscape Characterization***
  - GIS Data Layers
  - Landscape Metrics
- ***Stream Condition and Stressor Association Landscape Indicators***
  - Generation of Catchments for Surface Water Monitoring Sites
  - Generation of Landscape Metrics for Catchments
  - Landscape Model Development
  - Landscape Model Application

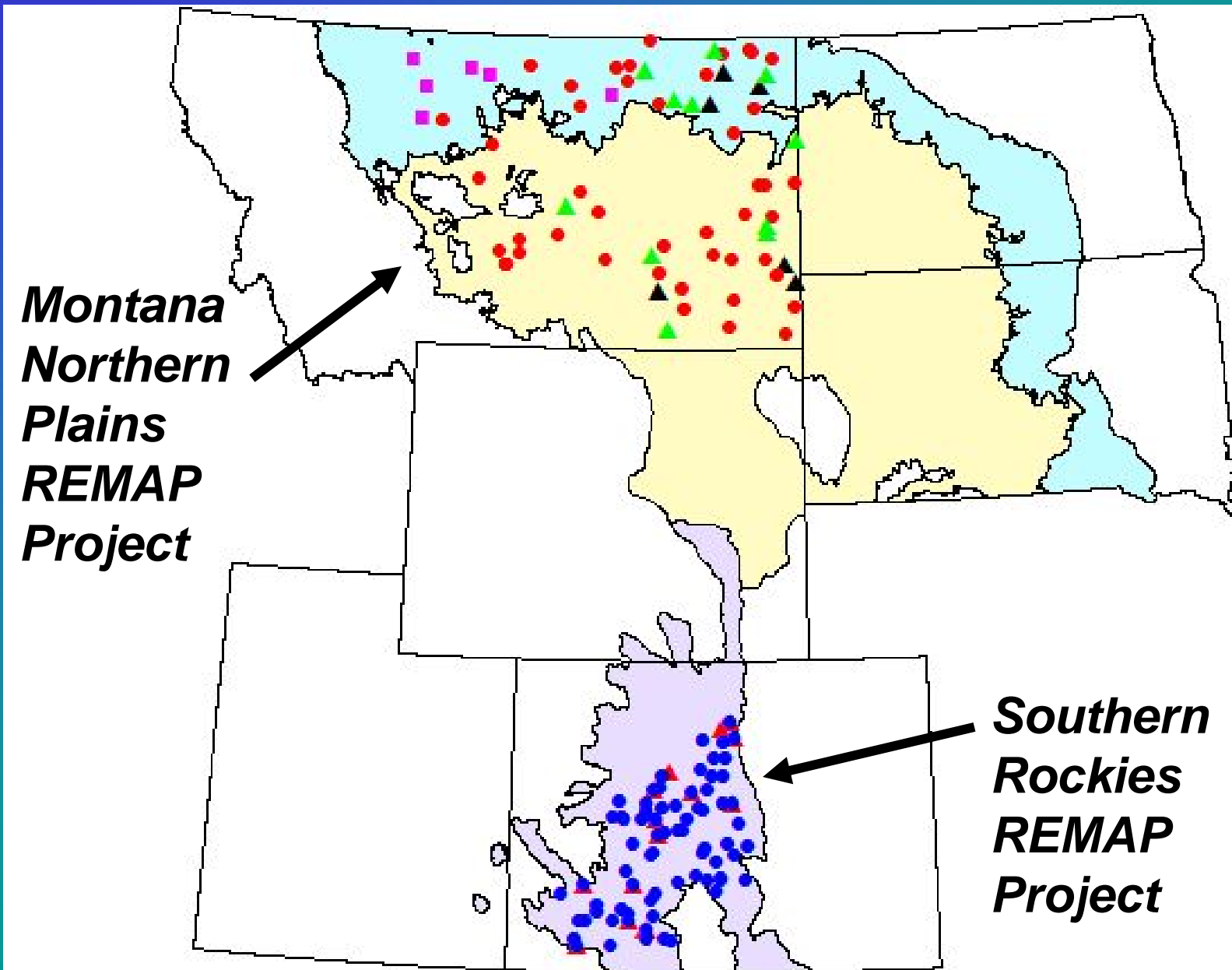
## ***EMAP-West Landscape Data***

- **Catchments for 2000, 2001, and 2002 Sites**
- **1992 National Land Cover Dataset (NLCD)**
- **National Hydrographic Dataset (NHD) (RF3)**
- **Geographic Data Technology (GDT) Roads**
- **National Elevation Dataset (NED)**
- **STATSGO (NRCS Soils)**
- **EPA Ecoregions (Omernik Level 3)**
- **US Census Tiger 2000**
- **USDA Agricultural Census**
- **USGS GeoData (8-digit HUCS, Administrative, ...)**
- **PRIZM, Geology, Mines, etc.**

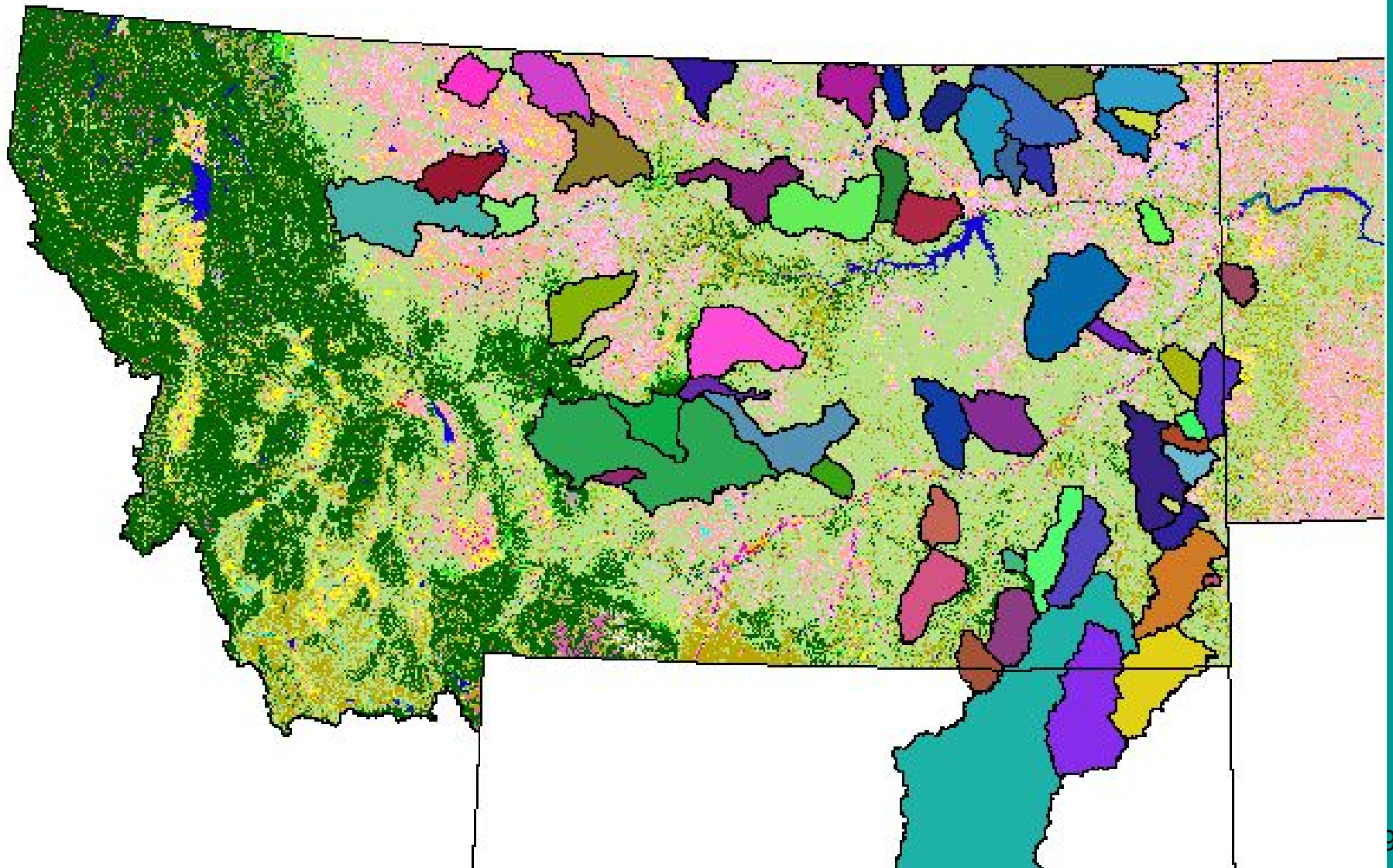
# Region 8 EMAP-West Monitoring Status



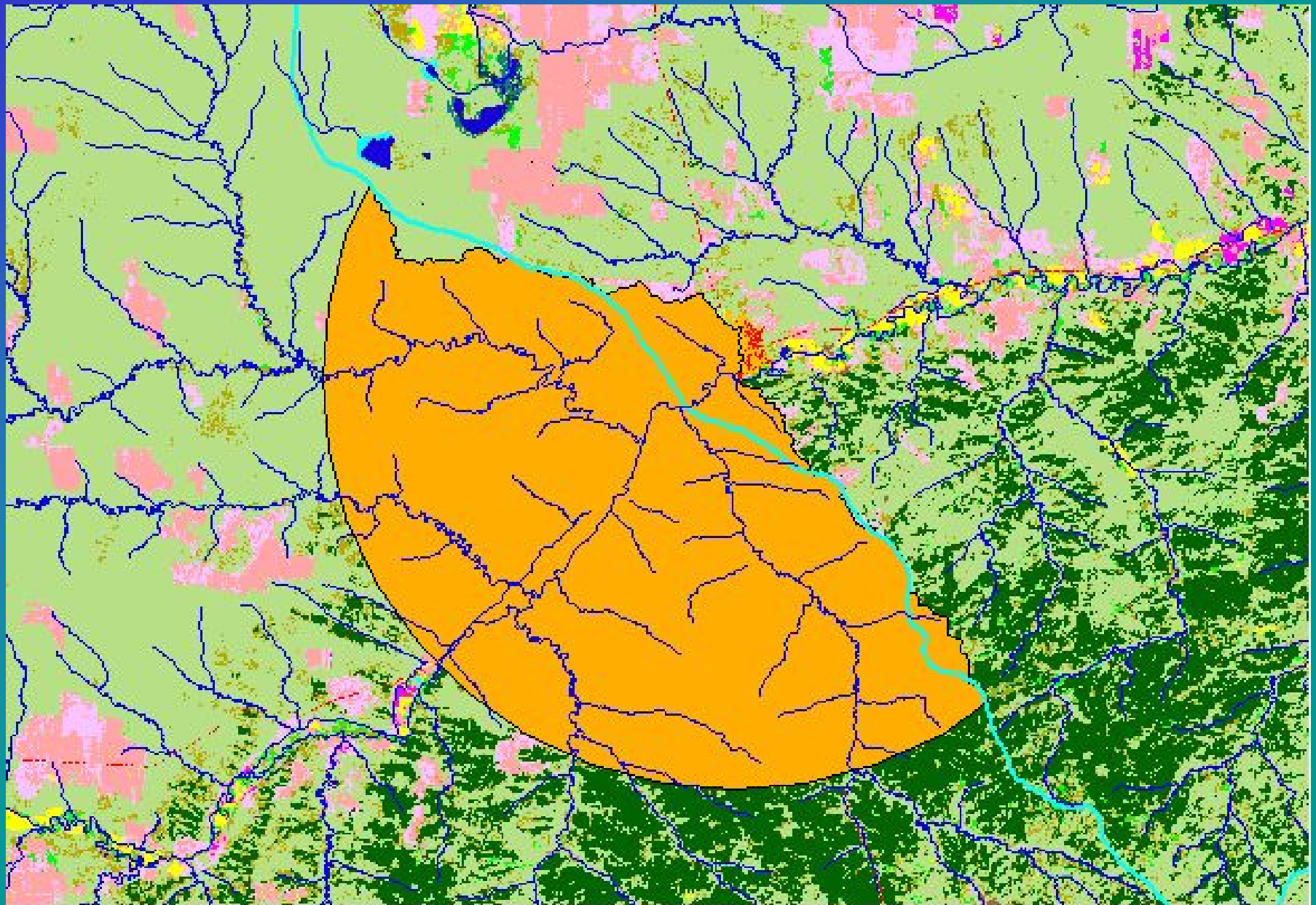
# Montana Northern Plains and Southern Rockies



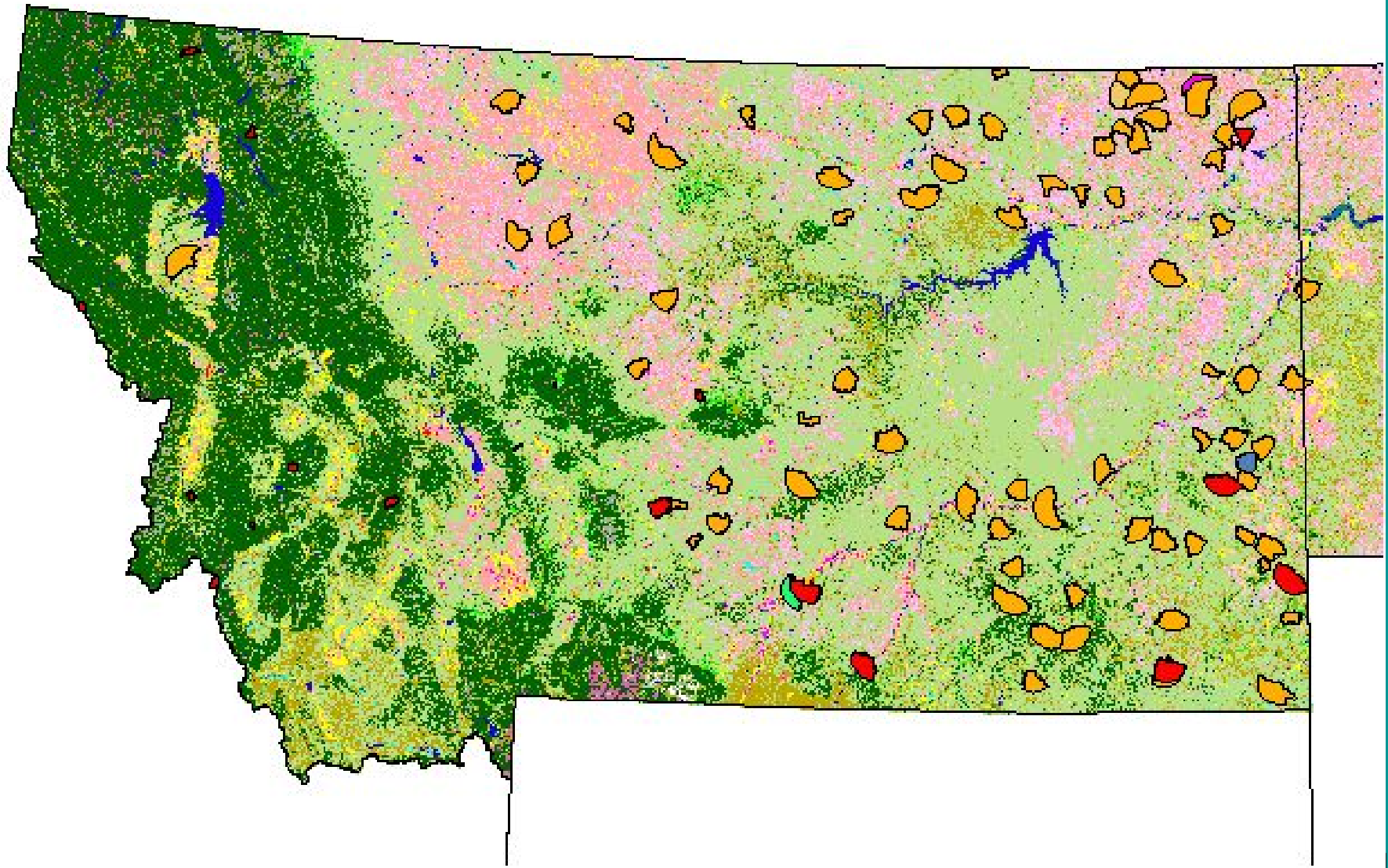
## *Full Catchments for MT Northern Plains Sites*



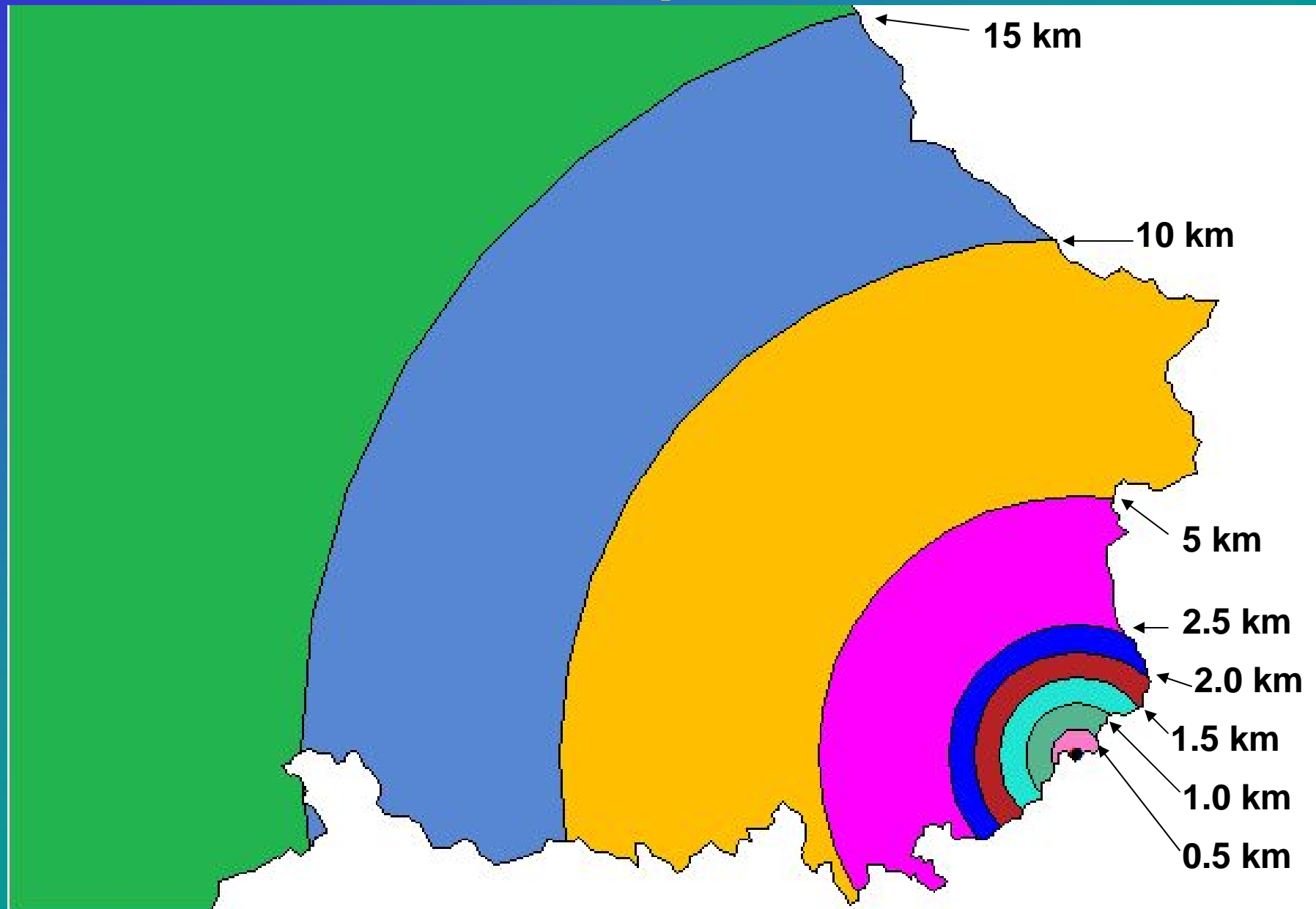
## *Catchment Definitions for EMAP-West*



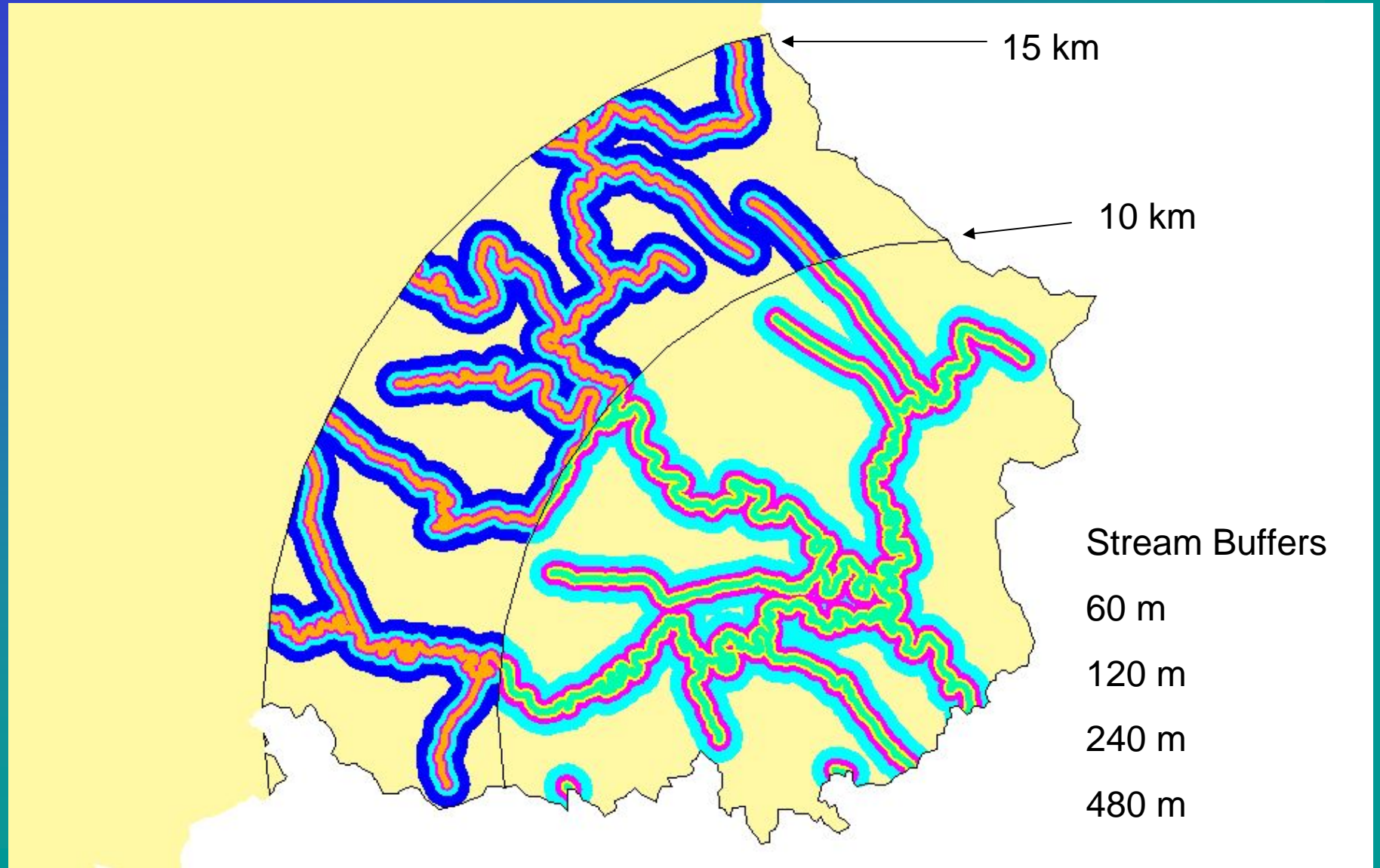
## 15 km clip of Montana Sites (REMAP, 2000, and 2001)



## *Distance from Site Clips*



## ***Buffer Distance from Stream are also Clipped with Distance from Sites***



# *Landscape Indicator Development for Potential Nutrient Impairment*

*The Model Concept is that*

*Nutrient Concentrations are a function of:*

- **Anthropogenic Influence**
  - Land Cover Classes with Loading Factors
    - Road Class translation into Land Cover classes
  - Potential Grazing Impact
- **Atmospheric Deposition** (*modeled*)

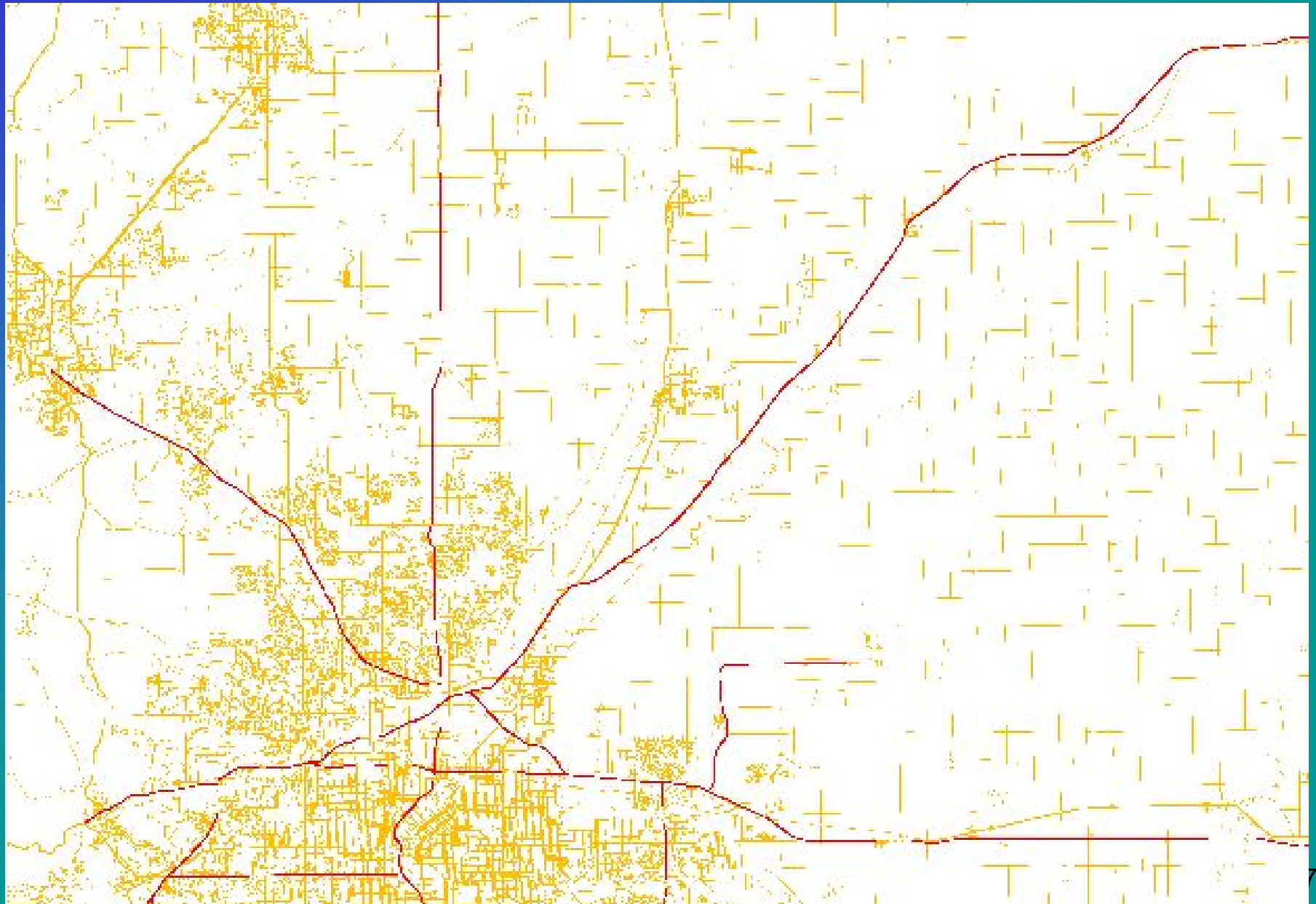
## *Landscape Indicator Development for Potential Nutrient Impairment*

- **Clipped and Buffered Catchments produced for EMAP-West 2000, 2001, MT Northern Plains and Southern Rockies REMAP Sites**
  - *Catchments for EMAP 2002 Sites underway*
- **Modified Land Cover produced** (*NLCD and Roads*)
- **Potential Grazing Impact** (*Region-wide Model*)
- **Nitrogen Deposition Model** (*acquired from OW*)
- **Landscape Metrics produced for catchments**
  - **PLOAD, NLOAD, and U\_INDEX**
    - From both NLCD and the modified NLCD (NLCD with roads)
  - **Nitrogen Deposition**
  - **Potential Grazing Impact**

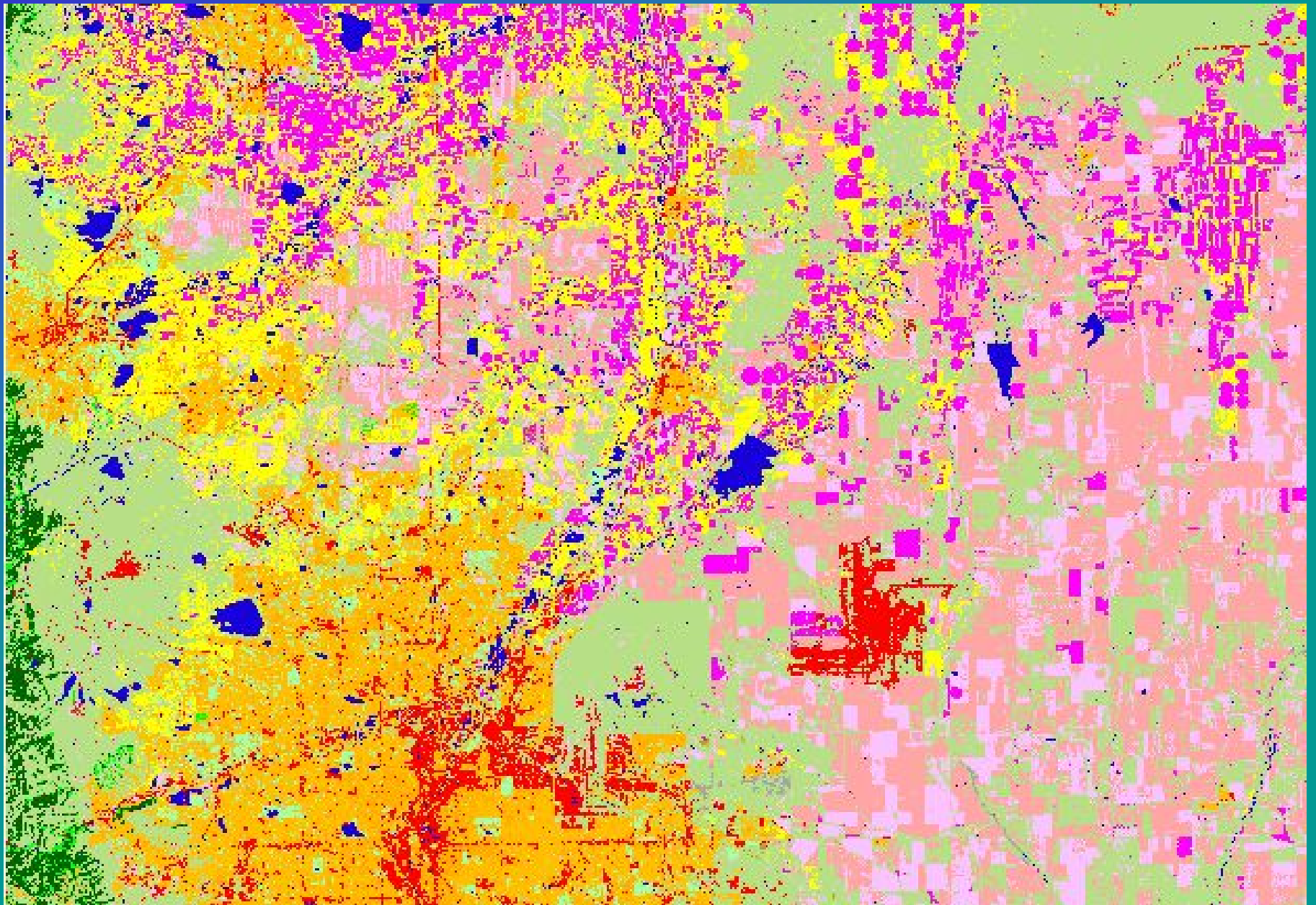
## *Development of the Modified National Land Cover Data (NLCD)*

- **Conversion of Road Class to Land Cover Class (RD-NLCD)**
  - Generate separate Grids for each RD class
  - FCC A1x => NLCD 23 with 90m width
    - Interstate equivalents to commercial/transportation
  - FCC A2x => NLCD 21 with 90m width
  - FCC A3x => NLCD 21 with 30m width
  - FCC A4x => NLCD 21 with 30m width
  - Merge all Grids into one RD-NLCD grid
    - NLCD 23 class has priority
- **Combine NLCD with RD-NLCD**
  - Urban classes take priority

## ***Roads reclassified in Land Cover Classes***



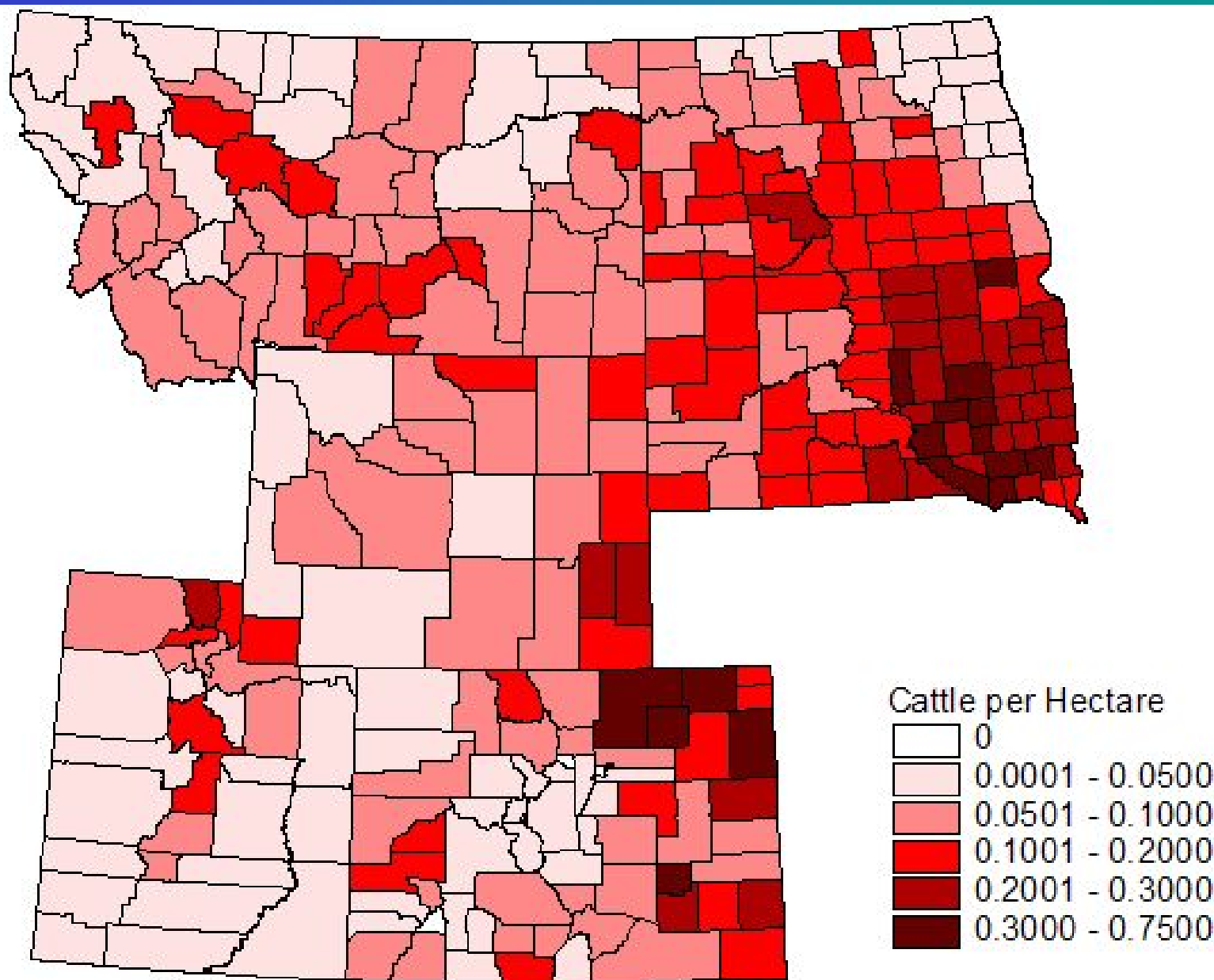
## *The NLCD classes for the same area*



## *Development of the Potential Grazing Impact Model*

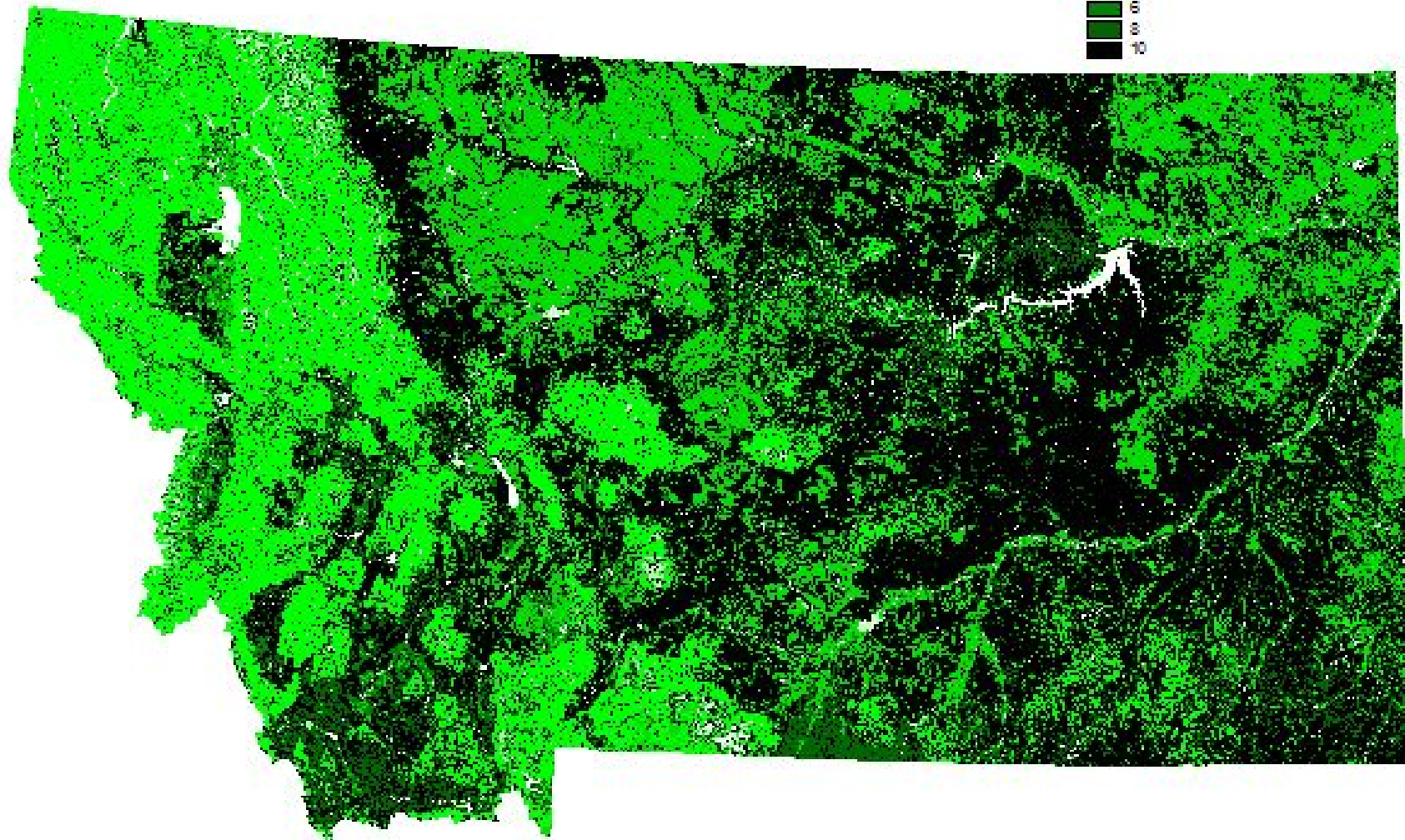
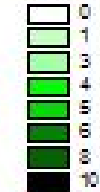
- **Model inputs are:**
  - **Weighted Land Cover**
  - **Weighted Administrative Land Uses**
  - **Topographic Profile Index**
  - **Number of Cattle**
  - **Proximity to Streams**

## *Cattle per Hectare in Region 8*

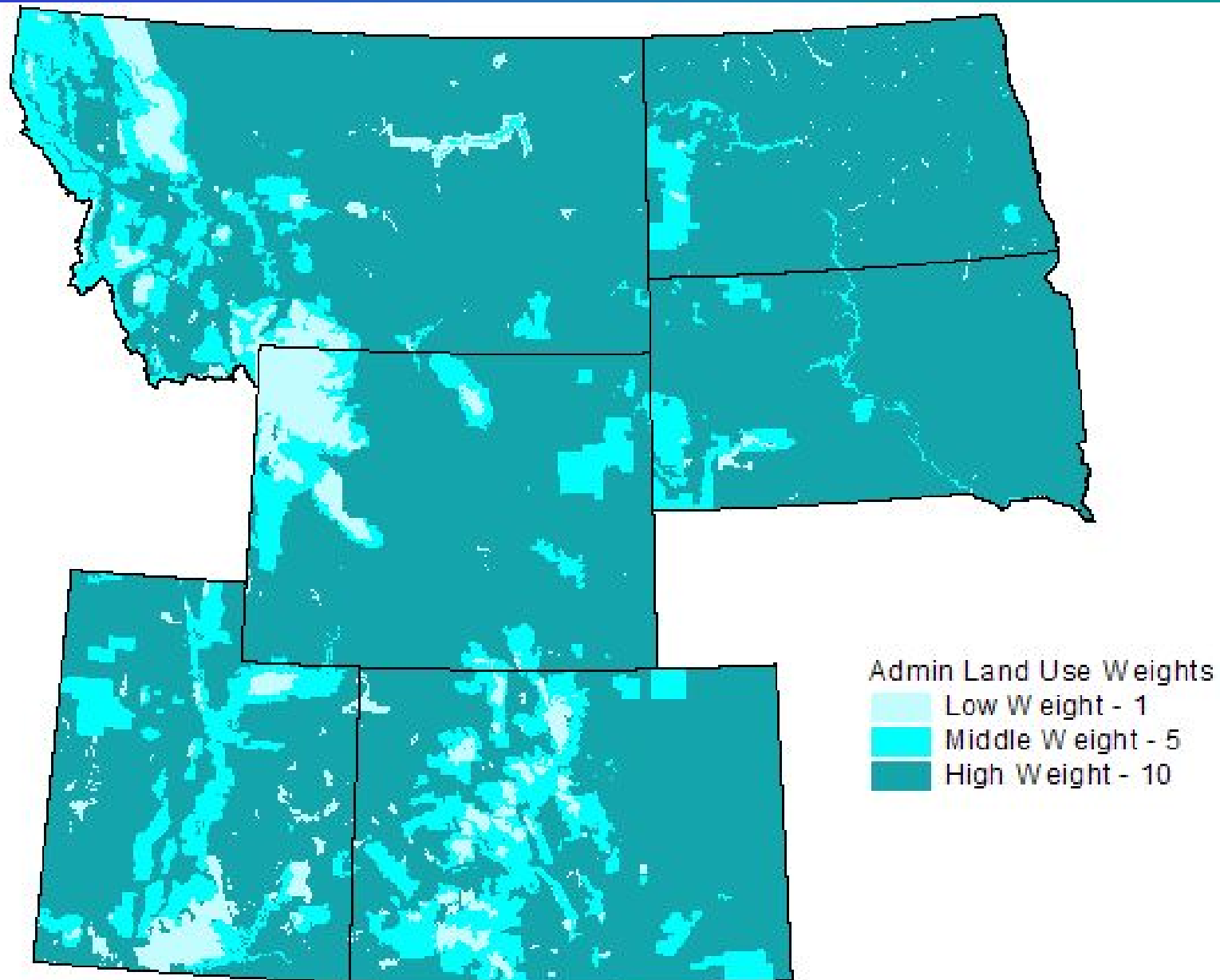


# Montana – Land Cover Weighting for Grazing

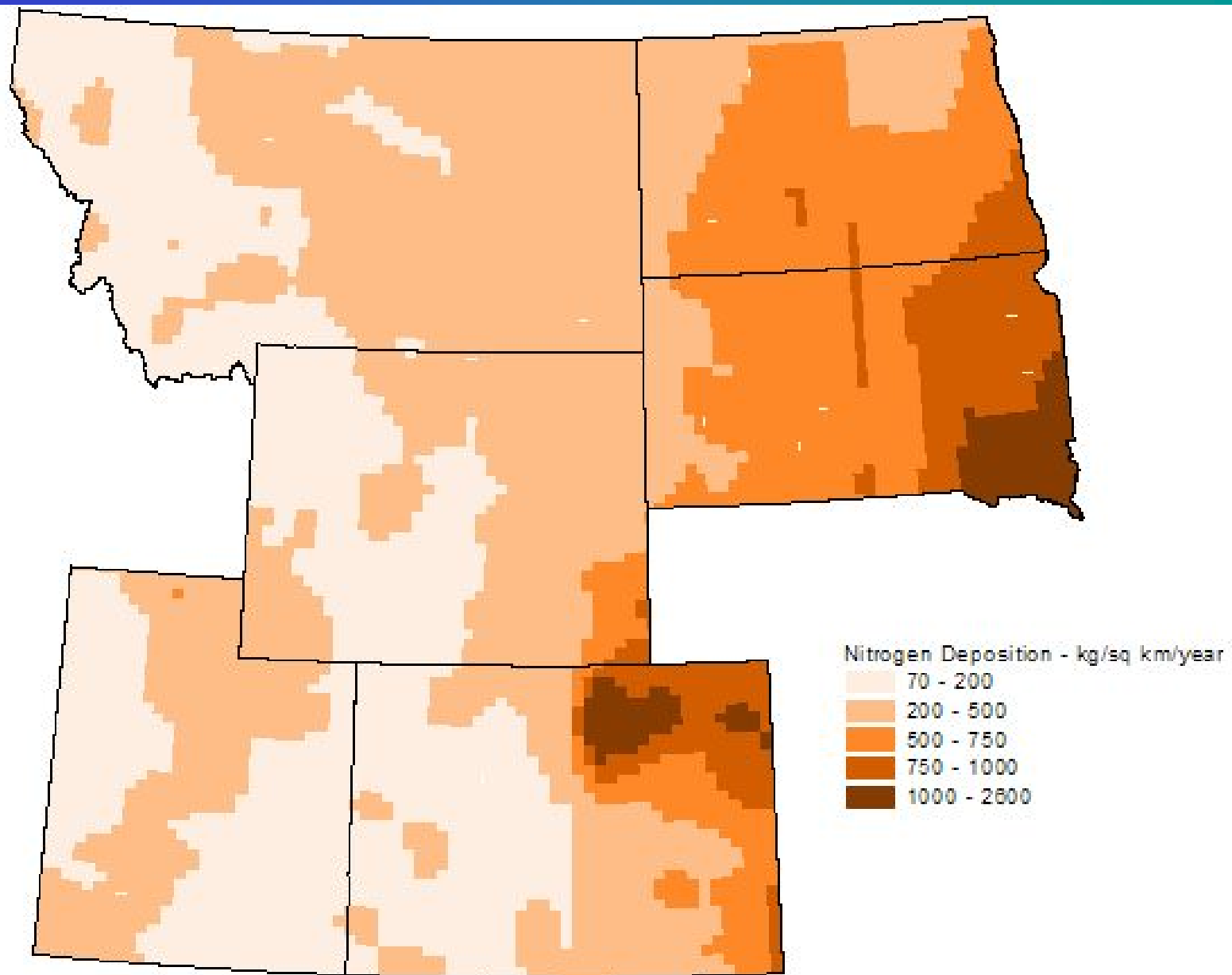
Land Cover Weights for Grazing



# *Administrative Land Use Weighting for Grazing*



## *Nitrogen Deposition – kg / sq km / year*



# Landscape Metrics – ArcView ATtiLA

ArcView GIS 3.3

File Edit View Theme Analysis Surface Graphics Window Help ATtiLA

np\_150\_all.apr NP Landscape Metrics

New Open

Example Catchment  
NP Full Catchment  
NP Landscape Metrics

Views  
Tables  
Charts  
Layouts  
Scripts

☒ Nplm01\_150.c  
☒ Streams  
☐ Hucs 8  
☒ States  
☐ Water Bodies  
☒ Mtlm00\_150.c  
☒ Mtlm01\_150.c  
☒ Mtlm042\_150.c  
☒ Mtlm0599\_150.c  
☐ Nplm01\_150.c  
☒ Nps08\_150.c  
☒ Nps01\_150.c  
☒ Np017\_150.c  
☒ Mtlm\_nlcd  
Water  
Snow/Ice  
Low-intensity  
High-intensity  
Commercial  
Bare Rock/Soil  
Quarries/Strip  
Transitional  
Deciduous Forest

Landscape Characteristics

Reporting Unit: Nplm01\_150.c Landcover: Mtlm\_nlcd  
ID Field: Npsite\_id Landcover Cell Size: 30

The current land cover class coding scheme is:

☐ Anderson I ☐ Anderson II ☒ NLCD ☐ SAA ☐ Custom

☒ N\_index ☒ U\_index ☐ Diversity (H, H', C, S)  
☒ Pfor ☒ Purb ☐ Cover Original  
☒ Pwetl ☒ Pagg ☐ AgtSL ☐ AgpSL  
☒ Pbar ☒ Pagg ☐ AgcSL ☐ UserSL  
☒ Pshrb ☒ Pagg  
☐ Png ☐ Puser

Slope: Mtlm\_nlcd  
Minimum Slope: 3  
Forest Edge Width: 7

Analysis Window: 9  
☐ Pff ☐ pFEde ☐ FEde  
☐ pFPtch ☐ pFPerf ☐ FCore  
☐ pFTran ☐ pFIntr ☐ Fea

Min. Patch Size: 1  
Max. Separation: 0  
FNumber  
FAvgSize  
FPatDens  
Search Radius: 100  
☐ MDCP

Output: Metric values only

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# Landscape Metrics – ArcView ATtiLA

ArcView GIS 3.3

File Edit View Theme Analysis Surface Graphics Window Help ATtiLA

np\_150\_all.apr NP Landscape Metrics

New Open

Example Calc  
Example Catch  
NP Full Catch  
NP Landscap

Views  
Tables  
Charts  
Layouts

NP Landscape Metrics

☒ Nplm01\_150c  
☒ Streams  
☐ Hucs 8  
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☒ Mtlm00\_150c  
☒ Mtlm01\_150c  
☒ Mt0642\_150c  
☒ Mt0599\_150c  
☐ Nplm01\_150c  
☒ Nps08\_150c  
☒ Nps01\_150c  
☒ Np017\_150c  
☒ Mtnl\_nlod  
Water  
Snow/Ice  
Low-intensity  
High-intensity  
Commercial  
Bare Rock/Ss  
Quarries/Strip  
Transitional  
Deciduous Fr

Human Stressors

Reporting Unit: Mtlm00\_150c Landcover: Mtnl\_nlod  
ID Field: Site\_id

The current land cover class coding scheme is:

☐ Anderson I ☐ Anderson II ☒ NLCD ☐ SAA ☐ Custom

	P	N
URB	1.2	5.5
PAS	0.9	5.0
RC	2.3	8.5
NRC	0.8	6.0
FOR	0.25	2.5
SHRB	0.04	0.4
NG	0.06	0.3
User	0.0	0.0

Census1: Nplm01\_150c  
Pop Field: None  
Census2: Nplm01\_150c  
Pop Field: None

☐ POPDENS ☐ POPCHG  
FOR: 0.02 OG: 0.10  
HDR: 0.60 HIC: 0.90  
LDR: 0.40 User: 0.00

☐ PCTIA\_LC

☒ P\_Load ☒ N\_Load

Stream: Streams  
Roads: Streams  
Class Field: Rch\_code

☐ RDDENS ☐ STXRD  
RDLEN

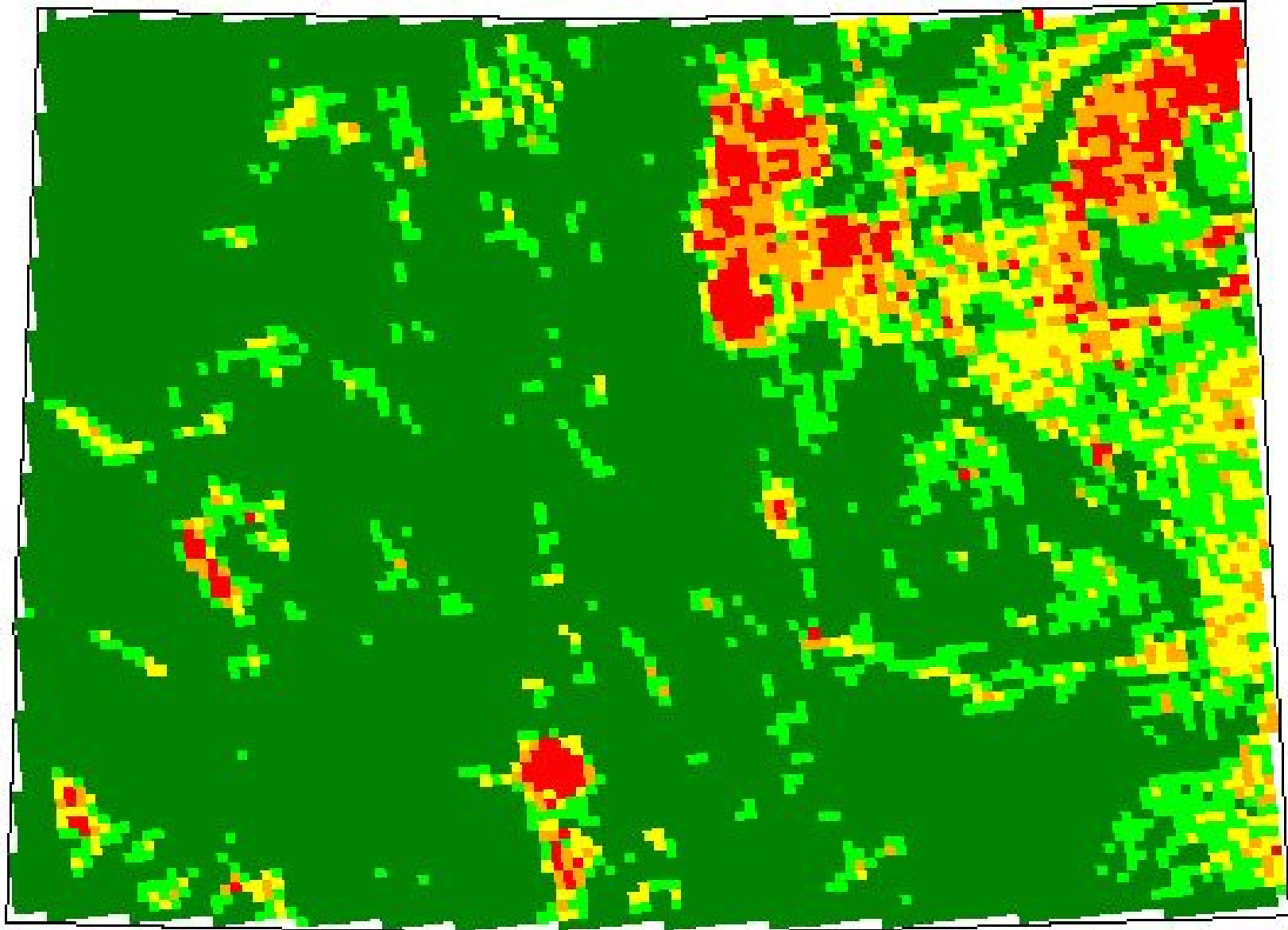
☐ PCTIA\_RD  
Within Distance: 30  
☐ STPRD

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## *The Different Nutrient Landscape Indicator Models being examined*

- $TN = f( NLOAD + \text{Grazing Impact} + \text{Nit Dep} )$
- $TN = f( NLOAD + \text{Grazing Impact} + \text{Nit Dep} )$ 
  - with NLOAD derived from modified NLCD
- $TN = f( U\_INDEX + \text{Grazing Impact} + \text{Nit Dep} )$
- $TP = f( PLOAD + \text{Grazing Impact} )$
- $TP = f( PLOAD + \text{Grazing Impact} )$ 
  - with PLOAD derived from modified NLCD
- $TP = f( U\_INDEX + \text{Grazing Impact} )$

## *Colorado – Potential Phosphorus (based only on land cover)*



**DRAFT**

*Yellow, orange, red – greater than 0.1 mg/L*

## *Questions / Comments?*

